AN OVERVIEW OF CHEMREC® PROCESS CONCEPTS

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AN OVERVIEW OF CHEMREC® PROCESS CONCEPTS

1. CHEMREC - Major Applications
2. Development Milestones of CHEMREC
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5. The Chemrec Booster in New Bern
6. Atmospheric BLG Performance
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9. BLGCC concept
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12. Performance - Chemrec BLGMF
13. BLGMF Process Biomass to Fuel Efficiency
14. Technical Development
1. CHEMREC® - MAJOR APPLICATIONS

**Ready for commercialisation:**
- Booster (atmospheric air blown gasification)
  - Relieve overloaded recovery boilers
  - Capacity expansion projects

**Continued development:**
- BLGCC - Black Liquor Gasification Combined Cycle (pressurised oxygen-blown gasification)
  - Replacing recovery boiler
  - Increasing green power production
  - Improved pulp cooking liquors
- BLGAMF - Black Liquor Gasification with Methanol/DME Production as Motor Fuels for Automotive Uses
  - Replacing recovery boiler
  - Introducing new profitable green product line
  - Improved pulp cooking liquors

2. CHEMREC® DEVELOPMENT MILESTONES

- Atmospheric pilot plant, 3 tDS/24 h, SKF, Hofors, 1987
- Booster demonstration plant, 75 tDS/24 h, AssiDomän, Frövi, 1991
- Pressurized air-blown pilot plant, 6 tDS/24 h, Stora Enso, Skoghall, 1994
- Commercial Booster plant, 300 tDS/24 h, Weyerhaeuser, New Bern, 1996
- Pressurized oxygen-blown rebuilt pilot, 10 tDS/24 h, Stora Enso, Skoghall, 1997
- Piteå Development Plant 1 engineering starts 2001
3. GASIFICATION TECHNOLOGY PRINCIPLES

4. ATMOSPHERIC, AIR-BLOWN BLACK LIQUOR GASIFICATION SYSTEM
5. THE CHEMREC BOOSTER IN NEW BERN

6. PERFORMANCE - CHEMREC BOOSTER

Black Liquor throughput: 200 - 400 tDS/d
Operating temperature: 950 °C
Pressure: 0.7 bar(g)
Carbon conversion: >99 %
Thermal efficiency: 45 %
Syngas LHV: 2.5 - 3.5 MJ/ Nm³

Composition:
- H₂: 10-15 %vol
- CO: 8-12 %vol
- CH₄: 0.2-1 %vol
- CO₂: 15-17 %vol
- N₂: 55-65 %vol

Na & Sulphur Separation: 15% of incoming S found in syngas.
7. THE PRESSURISED BLG SYSTEM

- Gasifier
- Quench
- Condenser
- Counter Current Condenser
- Condensate
- Oxygen Atomizing medium
- Raw Syngas
- LP-Steam
- MP-Steam
- C.W
- BFW
- Clean Cooled Syngas
- Weak wash
- Green Liquor
- HX
- Cleaned Syngas

8. THE BLG PROCESS - MILL INTEGRATION FLOW SCHEME

- Pressurized BLG Process
- Gasifier/Quench
- Gas Cleanup Plant
- Electric Power or Synfuel Plant
- Oxygen Plant
- Cooking Liquor Preparation
- Sulfur Conversion
- Green/White Liquor
- Polysulfide Liquor
- High Sulfdity Green Liquor
- Low Sulfdity Green Liquor
- SO₂
- H₂SO₄
- Oxygen
- EL Power or Methanol/DME
- Air
- Black Liquor
9. CHEMREC BLGCC PROCESS

10. PERFORMANCE - CHEMREC BLGCC

Black Liquor throughput: >1000 tDS/d
Operating temperature: 950 °C
Pressure: 30 bar(g)
Carbon conversion: >99 %
Total thermal efficiency: 80 %
Syngas LHV: 7 - 9.5 MJ/ Nm³

Composition:
- H₂: 30-35 % vol
- CO: 28-32
- CH₄: 0.5-2
- CO₂: 30-35
- N₂: 1-4

Na & Sulphur Separation: 55% of incoming S found in gas.
11. CHEMREC BLGMF CONCEPT (EXCL. BIOMASS BOILER)

- Gasifier
- Raw Gas Cooler
- Air Separation Unit
- Oxygen
- Pilot burner fuel
- Black Liquor
- Gasifier
- Quench
- Green Liquor to the Pulp mill
- Pre-wash
- Absorber
- Regen.
- H2S rich gas
- Abs I
- Abs II
- H2S absorpti
- H2S rich gas
- CO-shift
- 99.8%
- CO2
- Waste water
- 50%
- CO2
- Waste water
- 99.8% Methanol
- MeOH Distillation
- Claus Tail Gas
- Alt1
- Alt2
- Waste water
- 50%
- Syngas
- Compr.
- Syngas
- Compr.
- Combustible gases
- Purge + Flash gases
- 30 bar steam
- Raw Methanol
- MP+ LP Steam
- Air Separation unit
- Oxygen
- Electric Power
- pilot burner fuel
- LP Steam
- Pre-wash
- Tails
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- High S. Green Liquor
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13. BLGMF PROCESS BIOMASS TO FUEL EFFICIENCY

Production Efficiency = \frac{\text{Methanol/ DME}}{\text{Additional Renewable Energy}} = 65-75\% 

14. CHEMREC DEVELOPMENT PLANTS DP-1 AND DP-2

<table>
<thead>
<tr>
<th>Plant</th>
<th>Location</th>
<th>Process Units</th>
<th>Capacity (tDS per d/ MW)</th>
<th>Pressure (bar)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP2*</td>
<td>Kappa Kraftliner Piteå</td>
<td>- Full BLGCC concept</td>
<td>~300 / 45</td>
<td>32</td>
<td>- Fully develop the BLGCC concept. - Net product approx. 10 MW, and 35 t/h of steam.</td>
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*) Plant Investments Supported by a Grant from the Swedish Government of 238 MSEK, approx 25 Mill €